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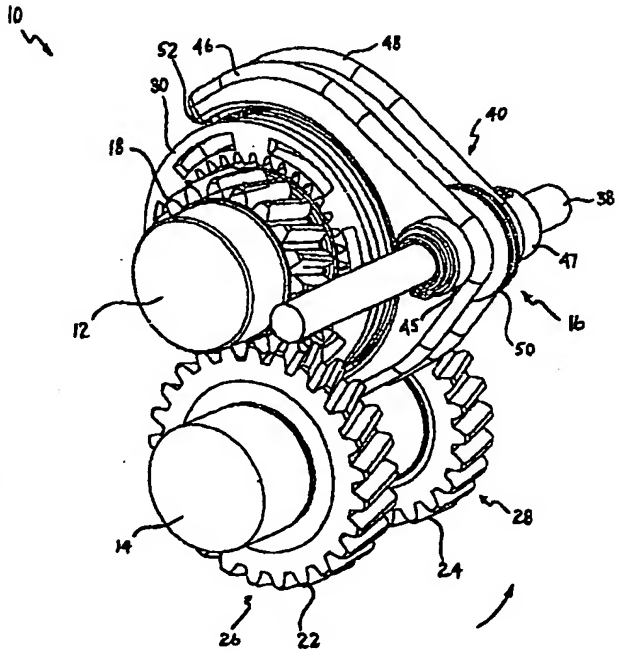
(54) Title: IMPROVED DOG-TYPE TRANSMISSION SYSTEM



(57) Abstract: An improved dog-type transmission system (10) with an input shaft (12) having first and second gear wheels (18, 20), an ouput shaft (14) having at least third and fourth gear wheels (26, 28) which continuously engage with the first and second gear wheels (18, 20) and a selector assembly (16) comprising first and second dog rings (34, 36) adjacent the first and second gear wheels (18, 20), interposed between them (18, 20), slidably rotating with the input shaft (12) and a fork assembly (40). Each dog ring (34, 36) has a first and a second surface, the surfaces respectively facing the adjacent dog ring (34, 36) and the adjacent gear wheel (18, 20). The first surface of the first dog ring (34) provides means for actually engaging the second gear wheel (20) in the direction of rotation of the input shaft (12). The first surface of the second dog ring (36) provides means for actually engaging the first gear wheel (18) in the opposite direction of rotation of the input shaft (12). The first surface of the second dog ring (36) provides means for actually engaging the first gear wheel (18) in the direction of rotation of the input shaft (12).The second surface of the second dog ring (36) provides means for actually engaging the second gear wheel (20) in the opposite direction of rotation of the input shaft (12). The actuator assembly (16) positions the first and second dog rings (34, 36) along the input shaft (12) thus selectively controlling the engagement means.

WO 01/29440 A1

'Improved Dog-Type Transmission System'

Field Of The Invention

The present invention relates to an improved dog-type transmission system. More particularly, the improved dog-type transmission system of the present invention is particularly suited for use in racing vehicles

Background Art

Known manual transmission systems typically rely on synchronising cones causing friction between the drive shaft and a particular gear wheel to enable synchronisation of their rotational speed and thereby allow transition between gear ratios. This approach adds a level of complexity to a transmission system, bringing with it associated cost and maintenance issues, and decreases the speed with which a change in gear ratio may be made.

In racing transmission systems, the speed with which a change of gear ratio may be made is paramount. Accordingly, in many racing transmission systems, no attempt is made at synchronisation before a new gear ratio is selected. 'Dog-type' systems utilise a dog ring to engage a selected gear wheel with a shaft in much the same manner as a conventional fully synchronised manual transmission system. However, unlike conventional fully synchronised manual transmission systems, dog-type systems do not use synchronising cones. So, to facilitate engagement of the dog ring with the selected gear, the dog rings in a dog-type system differ considerably from those in a conventional fully synchronised manual transmission system in that they comprise relatively few teeth with considerable backlash therebetween. This allows them to engage the selected gear despite the lack of synchronisation. However, the exaggerated backlash results in such systems being unsuitable for domestic vehicle use, and they are largely restricted to racing systems.

However, even in such dog-type systems, it is necessary to interrupt the supply of power to the transmission system to enable a dog-ring to be disengaged from a

gear wheel. This is clearly undesirable in a racing context and it is one object of the present invention to substantially overcome this problem.

The preceding discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgement or admission that any of the material referred to was part of the common general knowledge in Australia as at the priority date of the application.

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

Disclosure Of The Invention

In accordance with the present invention there is provided an improved dog-type transmission system comprising an input shaft, about which are rotatably provided first and second gear wheels, an output shaft, about which are fixedly provided third and fourth gear wheels, and a selector assembly, such that the first and second gear wheels continuously engage the third and fourth gear wheels respectively to provide at least two gear wheel pairs by either of which rotational energy may be transferred from the input shaft to the output shaft, the transmission system being characterised in that the selector assembly comprises first and second dog rings and an actuator assembly wherein the first and second dog rings are slidably provided about the input shaft, rotating in conjunction therewith, and are interposed between the first and second gear wheels, such that the first dog ring is adjacent the first gear wheel and the second dog ring adjacent the second gear wheel, each dog ring being provided with a first and a second surface, each second surface facing the adjacent gear wheel and each first surface facing the adjacent dog ring, and wherein, where the first gear wheel corresponds to a lower gear than the second gear wheel, provided about the second surface of the first dog ring are means for actuable engagement of the first gear wheel in a direction opposite the rotation of the input shaft, provided about

the first surface of the first dog ring are means for actuable engagement of the second gear wheel in the direction of rotation of the input shaft, provided about the second surface of the second dog ring are means for actuable engagement of the second gear wheel in a direction opposite the rotation of the input shaft and provided about the first surface of the second dog ring are means for the actuable engagement of the first gear wheel in the direction of rotation of the input shaft, and wherein the actuator assembly positions the first and second dog rings along the input shaft thereby selectively controlling the engagement of the means for actuable engagement in the direction of rotation of the input shaft and the means for actuable engagement in the direction opposite the rotation of the input shaft with the first and second gear wheels to in turn selectively control the transmission of rotational energy from the input shaft to the output shaft.

Preferably, considerable backlash is provided between the means for actuable engagement provided about each surface of each dog ring.

Preferably, the actuator assembly comprises a first actuator element operatively interconnected with the first dog ring, a second actuator element operatively interconnected with the second dog ring and a resiliently deformable means operatively interconnected with both the first and second actuator elements, such that movement of one actuator element causes deformation of the flexibly resilient means which in turn acts on the other actuator element.

Preferably, provided from the first surface of each of the first and second dog rings are one or more extensions, upon which the means for actuable engagement in the direction of rotation of the input shaft are provided. Preferably still, the extensions are dimensioned and positioned such that the extensions of the first dog ring may be interleaved with the extensions of the second dog ring.

In one form of the invention, the extensions are equidistantly spaced about the circumference of the first surface of each dog ring, and are arcuate in shape.

In a highly specific form of the present invention, three extensions are provided about the first surface of each dog ring, each extension occupying approximately

60° thereof, the extensions of the first dog ring being offset from the extensions of the second dog ring such that they may be interleaved.

Preferably still, the actuator assembly further comprises a selector rod and first and second collar members, and the first and second actuator elements are provided in the form of first and second selector forks, wherein the selector rod is provided substantially parallel to the input shaft, with the first and second selector forks being slidably provided about the selector rod between the first and second collar members which are fixedly provided about the selector rod, the resiliently deformable means being provided between the first and second selector forks.

In a highly preferred form of the invention, at least one selector fork is slidably provided about the selector rod such that the angle of the selector fork to the selector rod may be varied.

In one form of the invention, the or each resiliently deformable means is provided in the form of one or more springs. In a specific embodiment of the invention, the or each resiliently deformable means is provided in the form of a disc spring.

Preferably, each selector fork is operatively interconnected with the corresponding dog ring by way of one or more engagement pins provided on each selector fork engaging a recess provided about the circumference of each dog-ring.

Preferably, the selector assembly further comprises first and second recess rings interposed between and fixed to the first and second gear wheels respectively, and between which the first and second dog rings are interposed, wherein provided in the recess rings are a series of apertures adapted to receive the means for actuable engagement in the direction of rotation of the input shaft, and the means for actuable engagement in the direction opposite the rotation of the input shaft.

In one form of the invention, each means for actuable engagement is provided in the form of a ramp adapted to be received by an aperture in a recess ring, the ramp having an engagement surface substantially perpendicular to the surface of

the dog ring, and a sloping surface rising gradually from the surface of the dog ring to the engagement surface wherein, for the means for actuable engagement in the direction of rotation of the input shaft, the engagement surface leads the ramp on rotation, whilst for the means for actuable engagement in the direction opposite the rotation of the input shaft, the engagement surface trails the ramp.

Brief Description of the Drawings

The present invention will now be described by way of example only, with reference to one embodiment thereof and the accompanying drawings, in which:-

Figure 1 is a top view of an improved dog-type transmission system in accordance with the embodiment;

Figure 2 is a perspective view of the transmission system of Figure 1;

Figure 3 is a partial exploded view of the transmission system of Figures 1 and 2, showing in particular first and second dog rings and first and second recess rings; and

Figure 4 is a further partial exploded view of the transmission system of Figures 1 to 3, showing in particular the first and second dog rings of Figure 3 and a portion of an input shaft.

Best Mode(s) for Carrying Out the Invention

In Figures 1 to 4 there is shown a transmission system 10. The transmission system 10 comprises an input shaft 12, an output shaft 14 and a selector assembly 16. Rotatably provided about the input shaft 12 are first and second gear wheels 18 and 20. The first and second gear wheels 18 and 20 respectively engage third and fourth gear wheels 22 and 24 fixedly provided about the output shaft 14, to form first and second gear wheel pairs 26 and 28. The first gear wheel pair 26 corresponds to a lower gear than the second gear wheel pair 28, as can best be seen in Figure 1.

Rotational power may be transferred from the input shaft 12 to the output shaft 14 by way of either the first or second gear wheel pairs 26 or 28, as determined by positioning of the selector assembly 16.

The selector assembly 16 comprises first and second recess rings 30 and 32, first and second dog rings 34 and 36, a selector rod 38 and an actuator assembly in the form of a fork assembly 40.

The first recess ring 30 is provided about the input shaft 12, adjacent a surface of the first gear wheel 18 and fixed thereto. The second recess ring 32 is similarly provided about the input shaft 12, adjacent and fixed to a surface of the second gear wheel 20, such that the first and second recess rings 30 and 32 are interposed between the first and second gear wheels18 and 20, as can best be seen in Figure 2.

Also provided about the input shaft 12, interposed between the first and second recess rings 30 and 32 are the first and second dog rings 34 and 36. Provided about a portion of the input shaft 12 interposed between the first and second gear wheels 18 and 20 is a series of external splines 42, as can best be seen in Figure 3. The splines 42 engage corresponding internal splines 44 provided in each of the dog rings 34 and 36, such that the dog rings 34 and 36 are axially slidable along the input shaft 12, whilst rotating in conjunction therewith.

The selector rod 38 is provided parallel to the input shaft 12 and adjacent thereto. Provided about the selector rod 38 is the fork assembly 40, which comprises first and second collars 45 and 47, first and second selector forks 46 and 48, and a resiliently deformable means in the form of a spring 50, as can best be seen in Figure 4. The first and second collars 45 and 47 are fixed to the selector rod 38, with the first and second selector forks 46 and 48 being slidably provided therebetween. Interposed between and connecting the first and second selector forks 46 and 48 is the spring 50.

The selector fork 46 is provided with two engagement pins 52, which are slidably received within a circumferential recess 54 provided about the first dog ring 34

such that the engagement pins 52 do not interfere with the rotation of the first dog ring 34 with the input shaft 12. Similarly, the selector fork 48 is provided with two engagement pins 56, which are slidably received within a circumferential recess 58 provided about the second dog ring 36, such that the engagement pins 54 do not interfere with the rotation of the first dog ring 36 with the input shaft 12.

Referring specifically to Figures 2 and 3, the first dog ring 34 comprises an annular portion 60, having a first surface 62 and a second surface 64 wherein the first surface 62 faces the second gear wheel 20, whilst the second surface 64 faces the first gear wheel 18.

Equidistantly circumferentially spaced about the second surface 64 of the first dog ring 34 are three ramps 66. Each ramp 66 comprises a sloping portion 68 rising from the surface 64 to an engagement surface 70, arranged such that the sloping portion 68 leads the engagement surface 70 when the dog ring 34 is rotated.

The recess rings 30 and 32 each have provided therein a series of six arcuate recesses 72, equidistantly spaced about the circumference thereof. The three ramps 66 are positioned and adapted to be simultaneously received by three of the arcuate recesses 72 of the first recess ring 30.

Extending from the first surface 62 of the first dog ring 34 are three arcuate extensions 74. The arcuate extensions 74 are equidistantly spaced and each occupies 60° of the circumference of the first dog ring 34. Extending from each of the arcuate extensions 74 is a ramp 76, each ramp 76 comprising a sloping portion 78 rising from the arcuate projection 74 to an engagement surface 80. The sloping portion 78 is arranged with respect to the engagement surface 80 such that the engagement surface 80 leads the sloping portion 78 when the dog ring 34 is rotated. The three ramps 76 are positioned and adapted to be simultaneously received by three of the arcuate recesses 72 of the second recess ring 32.

The second dog ring 36 comprises an annular portion 82, having a first surface 84 and a second surface 86 wherein the first surface 84 faces the first gear wheel 18, whilst the second surface faces the second gear wheel 20.

Equidistantly circumferentially spaced about the second surface 84 of the second dog ring 36 are three ramps 88. Each ramp 88 comprises a sloping portion 90 rising from the surface 86 to an engagement surface 92, arranged such that the sloping portion 90 leads the engagement surface 92 when the dog ring 36 is rotated.

The three ramps 88 are positioned and adapted to be simultaneously received by three of the arcuate recesses 72 of the second recess ring 32.

Extending from the first surface 84 of the second dog ring 36 are three arcuate extensions 94. The arcuate extensions 94 are equidistantly spaced and each occupies 60° of the circumference of the first dog ring 34, such that the arcuate extensions 94 of the second dog ring may be interleaved with the arcuate extensions 74 of the first dog ring 34.

Extending from each of the arcuate extensions 94 is a ramp 96, each ramp 96 comprising a sloping portion 98 rising from the arcuate extensions 94 to an engagement surface 100. The sloping portion 98 is arranged with respect to the engagement surface 100 such that the engagement surface 100 leads the sloping portion 98 when the dog ring 36 is rotated. The three ramps 96 are positioned and adapted to be simultaneously received by three of the arcuate recesses 72 of the first recess ring 30.

When the lower gear of the first gear wheel pair 22 is engaged, the selector rod 38 is located such that the first and second selector forks 46 and 48 maintain the first and second dog rings 34 and 36 in such a position that the ramps 66 provided about the second surface 64 of the first dog ring 34 and the ramps 96 on the arcuate extensions 94 of the second dog ring simultaneously engage alternate arcuate recesses 72 of the first recess ring 30. The extensions 94 of the second dog ring 36 are interleaved with the extensions 74 of the first dog ring 34.

Accordingly, power is transferred from the input shaft 12, to the first dog ring 34 and the second dog ring 36, and to the first gear wheel 18 by way of the first recess ring 30. Power is transmitted to the output shaft 14 via the third gear wheel 22.

Whilst accelerating in the lower gear of the first gear wheel pair 22, the engagement surfaces 70 of the ramps 66 of the first dog ring 34 are not loaded, whilst the engagement surfaces 100 of the ramps 96 of the second dog ring 36 are. When a user (not shown), or an engine management system (not shown) wishes to engage the higher gear of the second gear wheel pair 24, the selector rod 38 is moved such that the first collar 45 acts on the first selector fork 46, which in turn acts on the first dog ring 34, causing such to axially slide along the input shaft 12 thereby disengaging the ramps 66 from the first recess ring 30.

Because the ramps 96 of the second dog ring 36 are loaded they cannot be disengaged, so the second selector fork 48 and the second dog ring 36 remain stationary. However, the movement of the first selector fork 46 causes the spring 50 to be further compressed, thereby applying force on the second selector fork 48 and the second dog ring 36.

As the first selector fork 46 causes the first dog ring 34 to slide axially along the input shaft 12, the ramps 76 engage the arcuate recesses 72 of the second recess ring 32. The engagement surfaces 80 then begin to drive the second gear wheel 20, and energy is transmitted from the input shaft 12 to the output shaft 14 by way of the second gear wheel pair 28.

As this occurs, the ramps 96 of the second dog ring 36 cease to be loaded. Thus, the spring 50 is released, causing the second selector fork 48 to slide axially along the selector rod 38, and thus the second dog ring 36 to slide axially along the input shaft 12 thereby completing the disengagement of the first gear wheel 18 therefrom. The second dog ring 36 continues to slide along the input shaft until the ramps 88 engage the arcuate recesses 72 of the second recess ring 32, thereby completing the engagement of the second gear wheel 20 with the input shaft.

Transition from the higher gear of the second gear wheel pair 28 to the lower gear of the first gear wheel pair 26 whilst decelerating is achieved by a similar process.

Whilst decelerating in the higher gear of the second gear wheel pair 24, the engagement surfaces 80 of the ramps 76 of the first dog ring 34 are not loaded, whilst the engagement surfaces 92 of the ramps 88 of the second dog ring 36 are. When a user (not shown), or an engine management system (not shown) wishes to engage the lower gear of the first gear wheel pair 24, the selector rod 38 is moved such that the first collar 45 no longer bears upon the first selector fork 46, allowing the spring 50 to act thereupon, causing the first selector fork 46 to axially slide along the selector rod 38. The first selector fork 46 acts on the first dog ring 34, causing such to axially slide along the input shaft 12 in the direction of the first gear wheel 18, thereby disengaging the ramps 76 from the arcuate recesses 72 of the second recess ring 32.

Because the ramps 88 of the second dog ring 36 are loaded they cannot be disengaged, so the second selector fork 48 and the second dog ring 36 remain stationary. However, the action of the second collar 47 on the second selector fork 48, arising from the movement of the selector rod 38, causes the a top portion of the second selector fork 48 to move in the direction of the first gear wheel 18, engagement pins 52 are still engaged with the circumferential recess 58 of the second dog ring 36, the ramps 88 of which are still engaged with the arcuate recesses72 of the second recess ring 32.

As the first selector fork 46 causes the first dog ring 34 to slide axially along the input shaft 12, the ramps 66 engage the arcuate recesses 72 of the first recess ring 30. The engagement surfaces 70 then begin to drive the first gear wheel 18, and energy is transmitted from the input shaft 12 to the output shaft 14 by way of the first gear wheel pair 26.

As this occurs, the ramps 88 of the second dog ring 36 cease to be loaded. Thus, the second selector fork 48 becomes realigned, causing the second dog ring 36 to slide axially along the input shaft 12 thereby completing the disengagement of the second gear wheel 20 therefrom. The second dog ring 34 continues to slide

along the input shaft until the ramps 96 engage the arcuate recesses 72 of the first recess ring 30, thereby completing the engagement of the first gear wheel 18 with the input shaft.

Modifications and variations such as would be apparent to the skilled addressee are considered to fall within the scope of the present invention.

Claims

1. An improved dog-type transmission system comprising an input shaft, about which are rotatably provided first and second gear wheels, an output shaft, about which are fixedly provided third and fourth gear wheels, and a selector assembly, such that the first and second gear wheels continuously engage the third and fourth gear wheels respectively to provide at least two gear wheel pairs by either of which rotational energy may be transferred from the input shaft to the output shaft, the transmission system being characterised in that the selector assembly comprises first and second dog rings and an actuator assembly wherein the first and second dog rings are slidably provided about the input shaft, rotating in conjunction therewith, and are interposed between the first and second gear wheels, such that the first dog ring is adjacent the first gear wheel and the second dog ring adjacent the second gear wheel, each dog ring being provided with a first and a second surface, each second surface facing the adjacent gear wheel and each first surface facing the adjacent dog ring, and wherein, where the first gear wheel corresponds to a lower gear than the second gear wheel, provided about the second surface of the first dog ring are means for actuable engagement of the first gear wheel in a direction opposite the rotation of the input shaft, provided about the first surface of the first dog ring are means for actuable engagement of the second gear wheel in the direction of rotation of the input shaft, provided about the second surface of the second dog ring are means for actuable engagement of the second gear wheel in a direction opposite the rotation of the input shaft and provided about the first surface of the second dog ring are means for the actuable engagement of the first gear wheel in the direction of rotation of the input shaft and wherein the actuator assembly positions the first and second dog rings along the input shaft thereby selectively controlling the engagement of the means for actuable engagement in the direction of rotation of the input shaft and the means for actuable engagement in the direction opposite the rotation of the input shaft with the first and second gear wheels to in turn selectively control the transmission of rotational energy from the input shaft to the output shaft.

2. An improved dog-type transmission system according to claim 1 characterised in that considerable backlash is provided between the means for actuable engagement provided about each surface of each dog ring.

3. An improved dog-type transmission system according to any one of the preceding claims characterised in that the actuator assembly comprises a first actuator element operatively interconnected with the first dog ring, a second actuator element operatively interconnected with the second dog ring and a resiliently deformable means operatively interconnected with both the first and second actuator elements, such that movement of one actuator element causes deformation of the flexibly resilient means which in turn acts on the other actuator element.

4. An improved dog-type transmission system according to any one of the preceding claims characterised in that, provided from the first surface of each of the first and second dog rings are one or more extensions, upon which the means for actuable engagement in the direction of rotation of the input shaft are provided.

5. An improved dog-type transmission system according to claim 4 characterised in that the extensions are dimensioned and positioned such that the extensions of the first dog ring may be interleaved with the extensions of the second dog ring.

6. An improved dog-type transmission system according to claim 4 or 5 characterised in that the extensions are equidistantly spaced about the circumference of the first surface of each dog ring.

7. An improved dog-type transmission system according to any one of claims 4 to 6 characterised in that the extensions are arcuate in shape.

8. An improved dog-type transmission system according to claim 7 characterised in that three extensions are provided about the first surface of each dog ring, each extension occupying approximately 60° thereof, the extensions of the

first dog ring being offset from the extensions of the second dog ring such that they may be interleaved.

9. An improved dog-type transmission system according to claim 3 or any one of claims 4 to 8 to the extent that it is dependent on claim 3, characterised in that the actuator assembly further comprises a selector rod and first and second collar members, and the first and second actuator elements are provided in the form of first and second selector forks, wherein the selector rod is provided substantially parallel to the input shaft, with the first and second selector forks being slidably provided about the selector rod between the first and second collar members which are fixedly provided about the selector rod, the resiliently deformable means being provided between the first and second selector forks.

10. An improved dog-type transmission system according to claim 9 characterised in that at least one selector fork is slidably provided about the selector rod such that the angle of the selector fork to the selector rod may be varied.

11. An improved dog-type transmission system according to claim 9 or 10 characterised in that the or each resiliently deformable means is provided in the form of one or more springs.

12. An improved dog-type transmission system according to claim 11 characterised in that the or each resiliently deformable means is provided in the form of a disc spring.

13. An improved dog-type transmission system according to any one of claims 9 to 12 characterised in that each selector fork is operatively interconnected with the corresponding dog ring by way of one or more engagement pins provided on each selector fork engaging a recess provided about the circumference of each dog-ring.

14. An improved dog-type transmission system according to any one of claims 9 to 13 characterised in that the selector assembly further comprises first and

second recess rings interposed between and fixed to the first and second gear wheels respectively, and between which the first and second dog rings are interposed, wherein provided in the recess rings are a series of apertures adapted to receive the means for actuable engagement in the direction of rotation of the input shaft, and the means for actuable engagement in the direction opposite the rotation of the input shaft.

15. An improved dog-type transmission system according to any one of the previous claims characterised in that each means for actuable engagement is provided in the form of a ramp adapted to be received by an aperture in a recess ring, the ramp having an engagement surface substantially perpendicular to the surface of the dog ring, and a sloping surface rising gradually from the surface of the dog ring to the engagement surface wherein, for the means for actuable engagement in the direction of rotation of the input shaft, the engagement surface leads the ramp on rotation, whilst for the means for actuable engagement in the direction opposite the rotation of the input shaft, the engagement surface trails the ramp.

16. An improved dog-type transmission system substantially as described herein with reference to Figures 1 to 4.

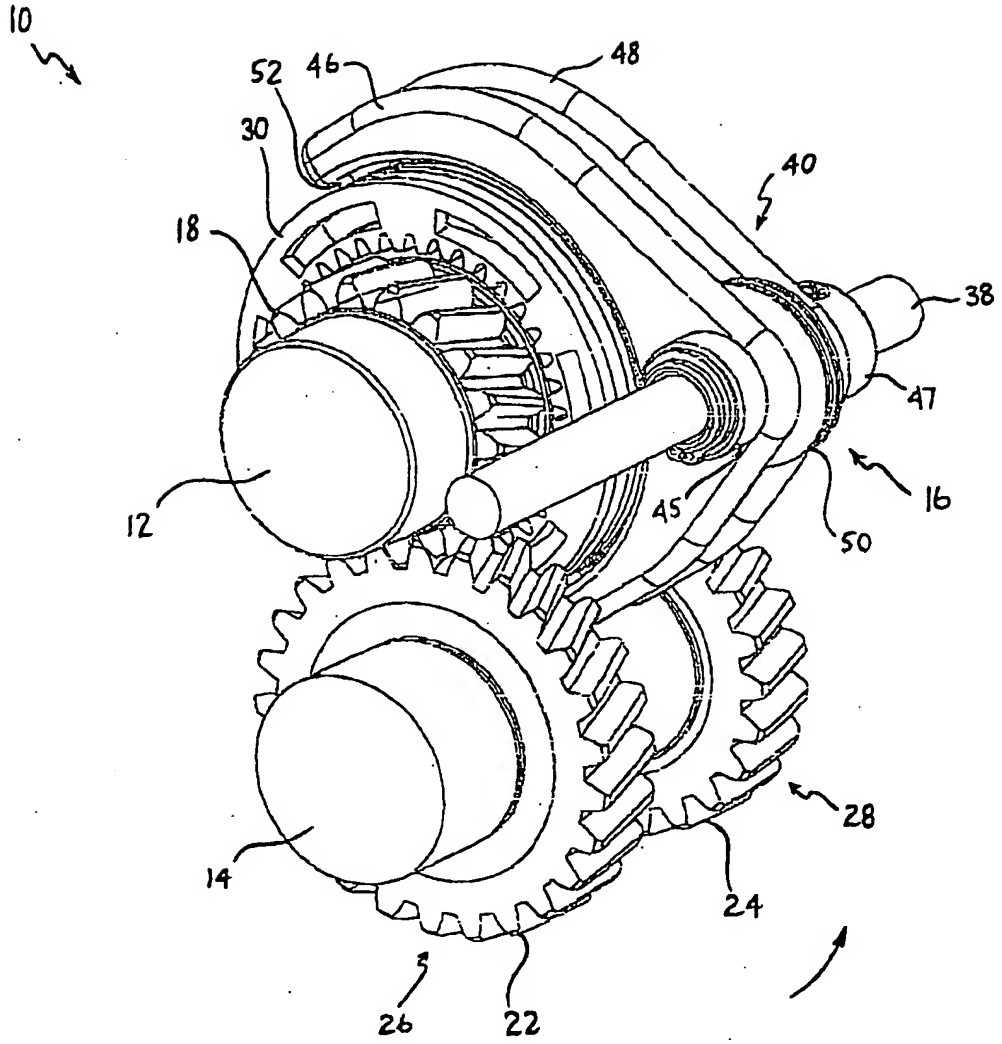


Fig. 1

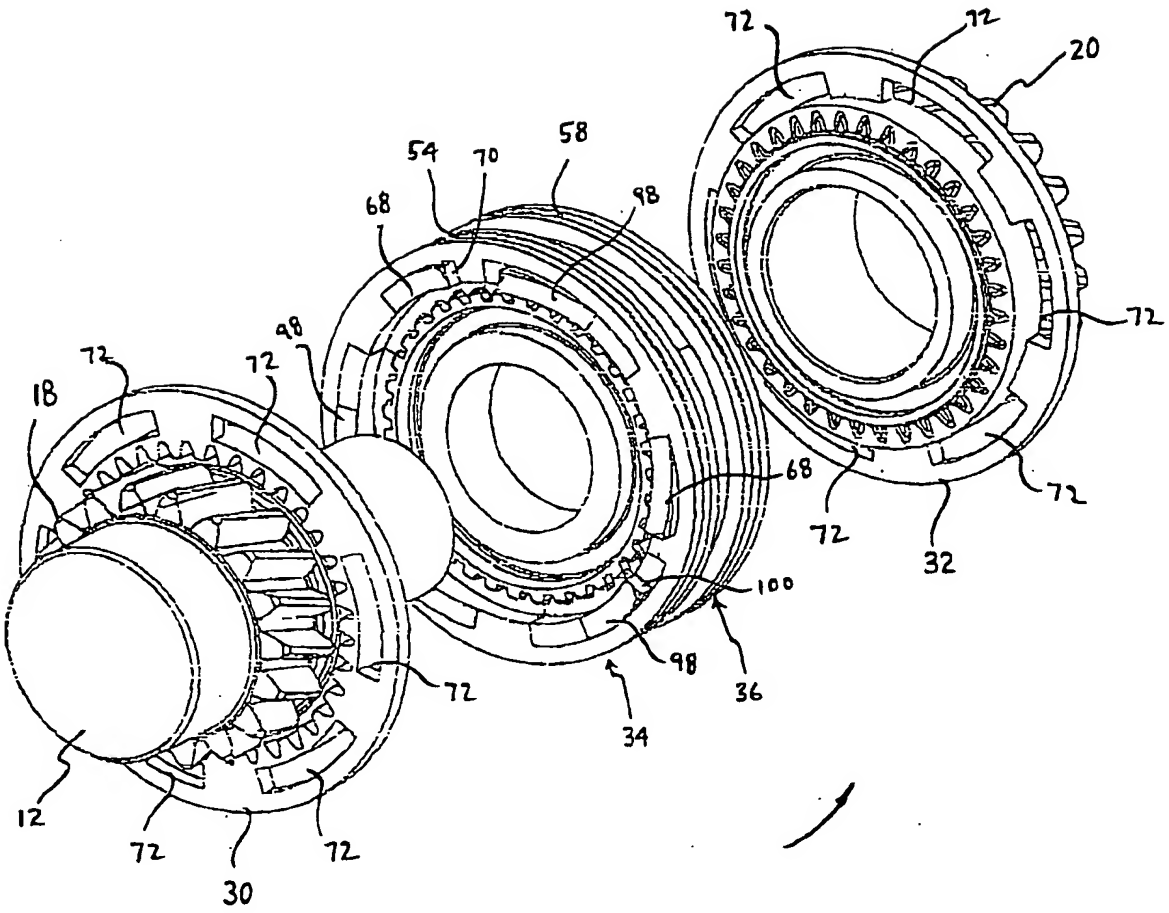

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Fig 2.

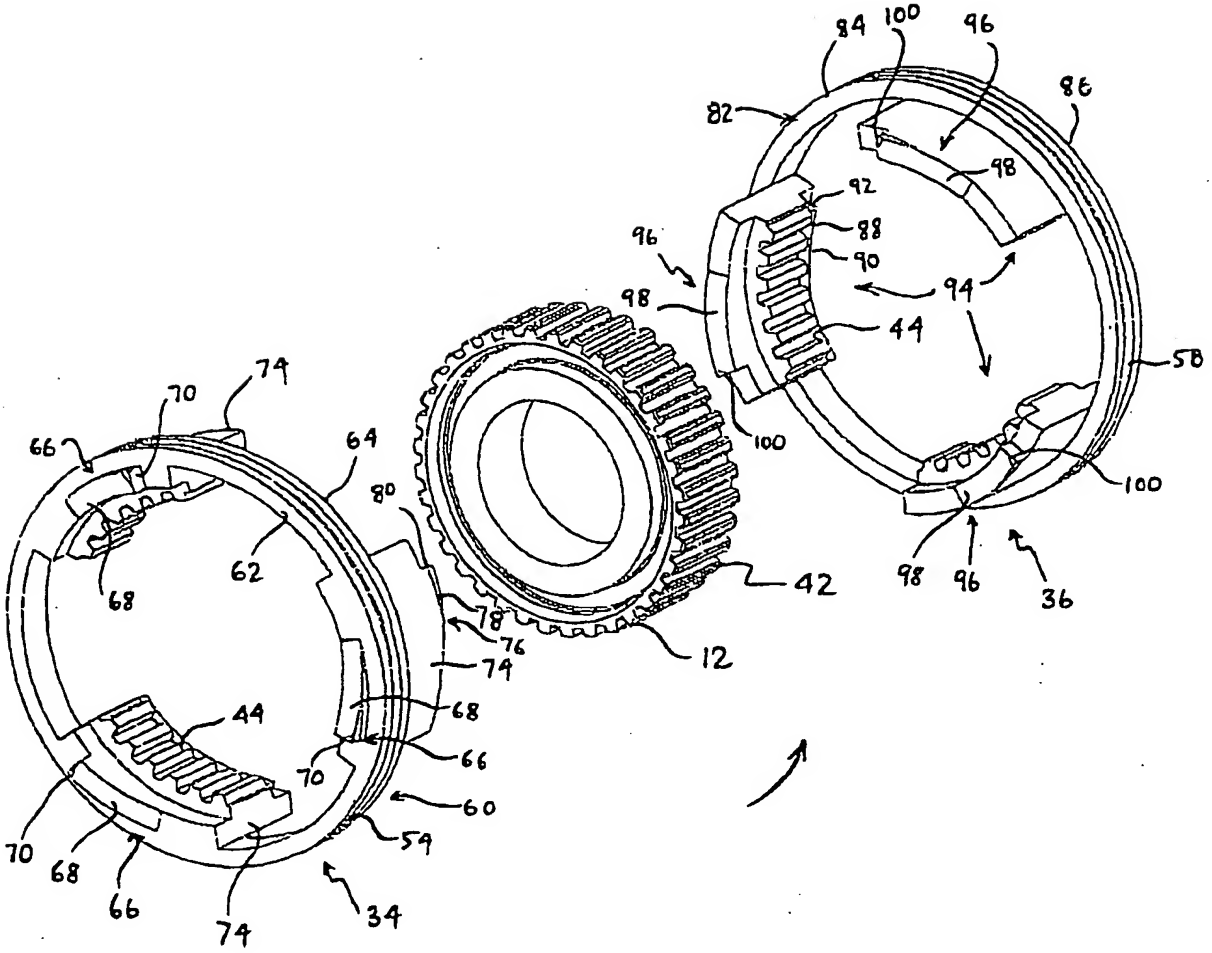
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Fig. 3.

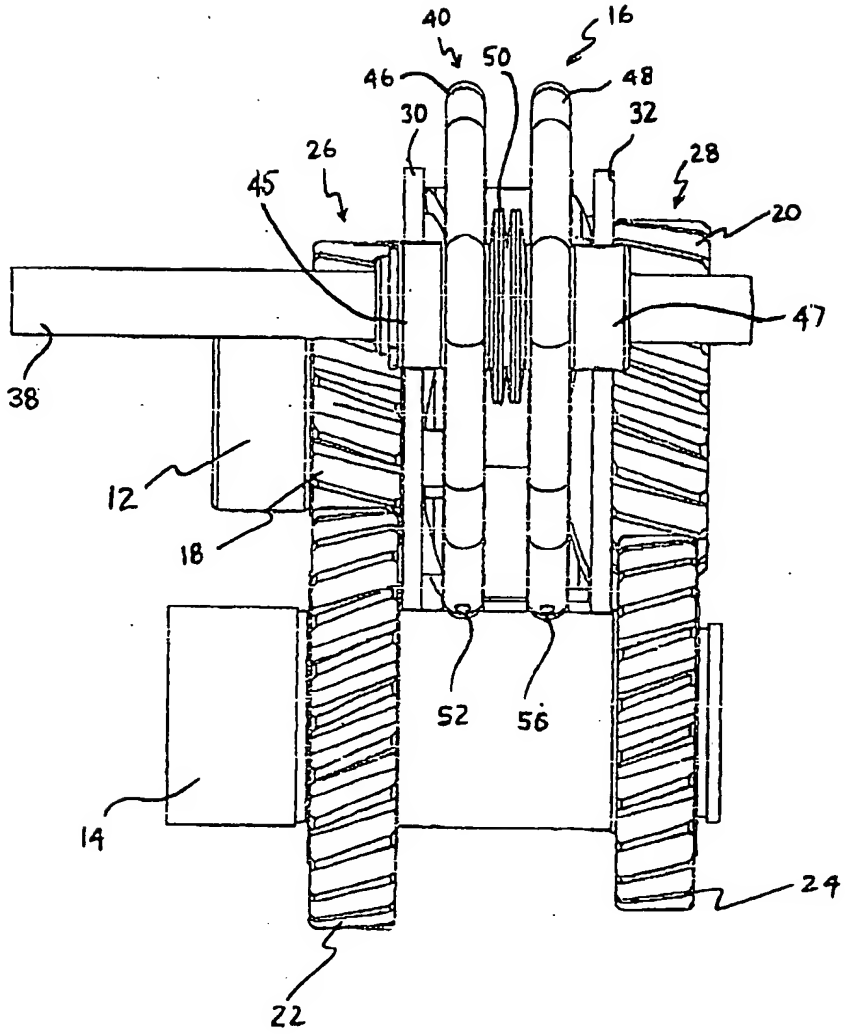

Fig. 4.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ00/00203

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: F16D 11/14, 11/10; F16H 3/083

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: F16D 11/14, 11/10; F16H 3/083

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC AS ABOVE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI Keywords search: (CLUTCH+ OR TRANSMISSION?) AND (AXIAL+ OR SLID+) AND DOG+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, Y	EP 1026418 A (PEUGEOT CITROEN AUTOMOBILES) 9 August 2000 Column 1 line 22 to column 8 line 28, claims 1 to 5 and figure 2	1-16
Y	US 4782929 A (MULLER) 8 November 1988 Column 2 line 51 to column 3 line 60, claims 1 to 9 and figure 1	1-16
Y	US 5560461 A (LOEFFLER) 1 October 1996 Column 2 line 48 to column 6 line 58, claims and figure 2	1-16

[X] Further documents are listed in the continuation of Box C [X] See patent family annex

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Date of the actual completion of the international search
15 February 2001

Date of mailing of the international search report
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Name and mailing address of the ISA/AU

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ00/00203

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5203225 A (GIUSTI) 20 April 1993 Column 1 line 40 to column 4 line 3, claims 1 to 4 and figure 2 Note: Disclosure of the last document, when combined with the disclosures of each of the previous documents, make the application defined in the claims obvious.	1-16

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/NZ00/00203

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
EP	1026418	FR	2789139				
US	4782929	DE	3612741	EP	241640	JP	62261738
US	5560461	AU	45714/96	CA	2168715		
US	5203225	EP	501417	IT	1245424	JP	5099334

END OF ANNEX